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NEOTYPIFICATION OF *SOLIDAGO SALICINA* (ASTERACEAE: ASTEREAE) AND A MULTIVARIATE COMPARISON WITH *S. PATULA*

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ABSTRACT

A neotype specimen is designated for *Solidago salicina* Ell., due to the likely loss or destruction of original material in CHARL. The species was treated as *Solidago patula* Muhl. subsp. *strictula* (Torr. & A. Gray) Semple in Flora North America. Multivariate morphometric analyses of all taxa in *Solidago* subsect. *Argutae* and a comparison of just *S. patula* and *S. salicina* indicate that species rank is warranted for the latter taxon.

KEY WORDS: *Solidago salicina*, *Solidago patula*, neotypification, multivariate morphometrics

Weatherby (1942) did not list a type collection for *Solidago salicina* Elliott as occurring in CHARL. A neotype is needed for the species name. Elliott (1824) described the species as having lanceolate scabrous leaves and a racemose inflorescence. He noted it occurred in Georgia and flowered in September and October. The name has been used in floras at the species level (e.g. Small 1903) or as a synonym of *Solidago patula* Muhl var. *strictula* Torr. & A. Gray or *S. patula* Muhl. subsp. *strictula* (Torr. & A. Gray) Semple, e.g., Cronquist (1980) and Semple and Cook (2006), respectively. Both species differ from other taxa in subsect. *Argutae* (Mackenzie in Small) G.L. Nesom in having very small scabrous hairs on the upper leaf surfaces. The results of a multivariate morphometric study of *Solidago* subsect. *Argutae* summarized below clearly indicate that this southeastern USA endemic taxon should be recognized at the species level.

Neotypification

Solidago salicina Ell., Sketch. Bot. S. Carolina 2: 389. 1824. TYPE: **USA. Georgia**. "Very common in the the oak land in the western districts," Sep-Oct; not listed by Weatherby (1942) as present in CHARL. NEOTYPE (designated here): **USA. Georgia**. Laurens Co.: swampy places 15 mi E of Dublin, 450 ft, 19 Oct 1947, *Cronquist 4880* (GH!). Figure 1.

Multivariate Analysis

A complete presentation of a multivariate analysis of all taxa in *Solidago* subsect. *Argutae* will be presented elsewhere. Pertinent to this publication are the results of a comparison of *S. patula* and *S. salicina* to each other. The methods followed were those summarized in several other publications on *Solidago* and *Symphyotrichum* (Heard & Semple 1988; Owen, Semple & Baum 2006; Cook, Semple & Baum 2009). In total, more than 200 specimens of taxa in subsect. *Argutae* were scored for 35 vegetative and floral traits. Specimens were obtained from GH, LSU, MO, NCU, NY, USF, and WAT (Thiers, continuously updated).

Discriminant analyses including Stepwise Discriminant Analysis (STEPDISC); Classificatory Discriminant Analysis and Canonical Analysis were performed using SYSTAT ver. 10 (SPSS Inc. 2000) on a data matrix.

Figure 1. Neotype of *Solidago salicina* Ell., *Cronquist 4880* (GH).

Two analyses were carried out involving 14 specimens of *Solidago patula* and 13 specimens of *S. salicina*. First, an analysis involving specimens of *S. arguta* (including var. *arguta*, var. *boottii*, var. *caroliniana*), *S. auriculata*, *S. brachyphylla*, *S. faucibus*, *S. harrisii*, *S. ludoviciana*, *S. patula*, *S. salicina*, *S. sphacelata*, *S. tarda*, and *S. verna* was carried out to assess the relative differences between *S. patula* and *S. salicina* compared to other species in the subsection. The full details of this first analysis will be presented elsewhere. Second, an analysis including just specimens of *S. patula* and *S. salicina* was carried out and the results are presented here. Specimens were assigned to two species level *a priori* groups (patula, salicina) on the basis of geographic location; northern and upland specimens were assigned to the patula group, while southern, lower elevation specimens were assigned to the salicina group. Specimens of *S. patula* came from Michigan, New York, North Carolina, Ontario, Tennessee, and Virginia. Specimens of *S. salicina* came from Alabama, Florida, Georgia, Louisiana, Mississippi, and North Carolina.

In a STEPDISC analysis of just *Solidago patula* and *S. salicina*, characters were selected as being most useful in separating the two species level *a priori* groups. In a subsequent complete analysis the following characters in order of descending F-to-remove value were used in the discriminant function: upper leaf length, disc floret number, upper leaf width, involucre height, and disc floret pappus length. The null hypothesis that there was only one group was tested using Wilks' lambda, Pillai's Trace and Lawley-Hotelling trace methods, and the null hypothesis was rejected (in each method p = 0.0000, indicating that the two groups were most likely not samples of the same group).

In the Classificatory Discriminant Analysis, all specimens of *Solidago patula* were placed *a posteriori* in the linear classification analysis into the patula group with 98-100% probability for 10 of the 14 specimens. Placement probabilities for three of the specimens ranged from 80-85%. One specimen was placed into the patula group with a probability of 69% — *Semple 11576* (WAT) from Polk Co., Tennessee. In the more rigorous Jackknife analysis, 12 of the 14 specimens of of *S. patula* were assigned *a posteriori* to the patula group.

In the Classificatory Discriminant Analysis, 12 of the 13 specimens of *Solidago salicina* were placed *a posteriori* in the linear classification analysis into the salicina group with 97-100% probability for 11 specimens. One specimen was placed into the salicina group with a probability of 82%. One specimen was placed into the patula group with a probability of 85% — *Godfrey s.n.* (GH) was collected in 1937 from Lead Mines, Raleigh, Wake Co., North Carolina. The specimen had mid stem damage and upper leaf traits were atypical. In the more rigorous Jackknife analysis, 1 of the 14 specimens of *S. patula* were assigned *a posteriori* to the patula group, i.e., there was no change from the linear analysis.

Morphological comparisons

Solidago patula and *S. salicina* are similar in being the only two species in subsect. *Argutae* having scabrous upper leaf surfaces with very short hairs, but they differ to varying degrees in other traits. Specimens of *S. salicina* are often more slender and can have more and smaller upper stem leaves than *S. patula*. Both species vary greatly in stem height, which can be as much as 1.3 m. Basal rosette and lower stem leaves are generally longer and have more marginal serrations in *S. patula* than *S. salicina*, but the ranges overlap and the differences are not diagnostic. The difference in lower stem leaf widths is more pronounced with *S. salicina* often having more linear lanceolate leaves. Mid leaf length is similar in the two species, but the leaves are generally shorter and narrower in *S. salicina*. Upper leaves of *S. salicina* can be much smaller than those of *S. patula*, but stem height significantly influences the size of upper leaves, which thus reduces the value of upper leaf size as a diagnostic trait by itself. There is little difference in the numbers of marginal serrations of the middle and upper leaves between the two species.

Involucre height is significantly different although the ranges overlap; mean involucre height in *Solidago patula* is 3.86 mm (range 2.5-6.5 mm); mean involucre height in *S. salicina* is 6.14 mm (range 3.5-8.8 mm). The difference in involucre height is clear in Fig. 2. The phyllaries of *S. patula* are often more obtuse and oblong than those of *S. salicina*. There is little difference in the number of rays, while *S. patula* has an average of 11.8 disc florets per head versus 9.3 disc florets per head in *S. salicina*.

Figure 2. Heads of (A) *Solidago patula* (*Semple 10589* WAT) and (B) *Solidago salicina* (*Thomas et al. 108382* WAT). Scale bars equal 1 mm.

The ranges in numbers and sizes of leaf and floral traits in the treatment of *Solidago patula* in Flora North America (Semple & Cook 2006) included data on both species. The ranges in character size and number overlap considerably, reducing the value of any character by itself, but in combination with other characters the multivariate analysis shows that two species differ significantly.

Chromosome numbers

Ploidy level is not a factor in this particular situation. All chromosome counts reported for both *Solidago patula* (Beaudry & Chabot 1959; Beaudry 1963, 1969; Jones 1968; Semple et al. 1981; Morton 1981; Semple et al. 1993; Semple & Cook 2004) and *S. salicina* (Beaudry 1963; Semple et al. 1984, Semple et al. 1993) were diploid, $2n$=18 or $2n=9_{II}$. Thus, the difference in involucre height is not a consequence of the ploidy level gigas effect.

Conclusion

These results support treating *Solidago salicina* as a species separate from *S. patula*. This fits with the allopatric distribution of the two species (Fig. 3). Also, in the larger subsectional analysis, the specimens of *S. patula* that were assigned *a posteriori* to other species groups were placed in different taxa than those specimens of *S. salicina* that were assigned to other species groups. This indicates that the two species differ in their technical similarities shared with other species in the subsection. Overall within subsect. *Argutae*, species differences are based more on leaf traits than floral traits other than numbers of ray florets, e.g., few or no rays in *S. sphacelata* and *S. brachyphylla*.

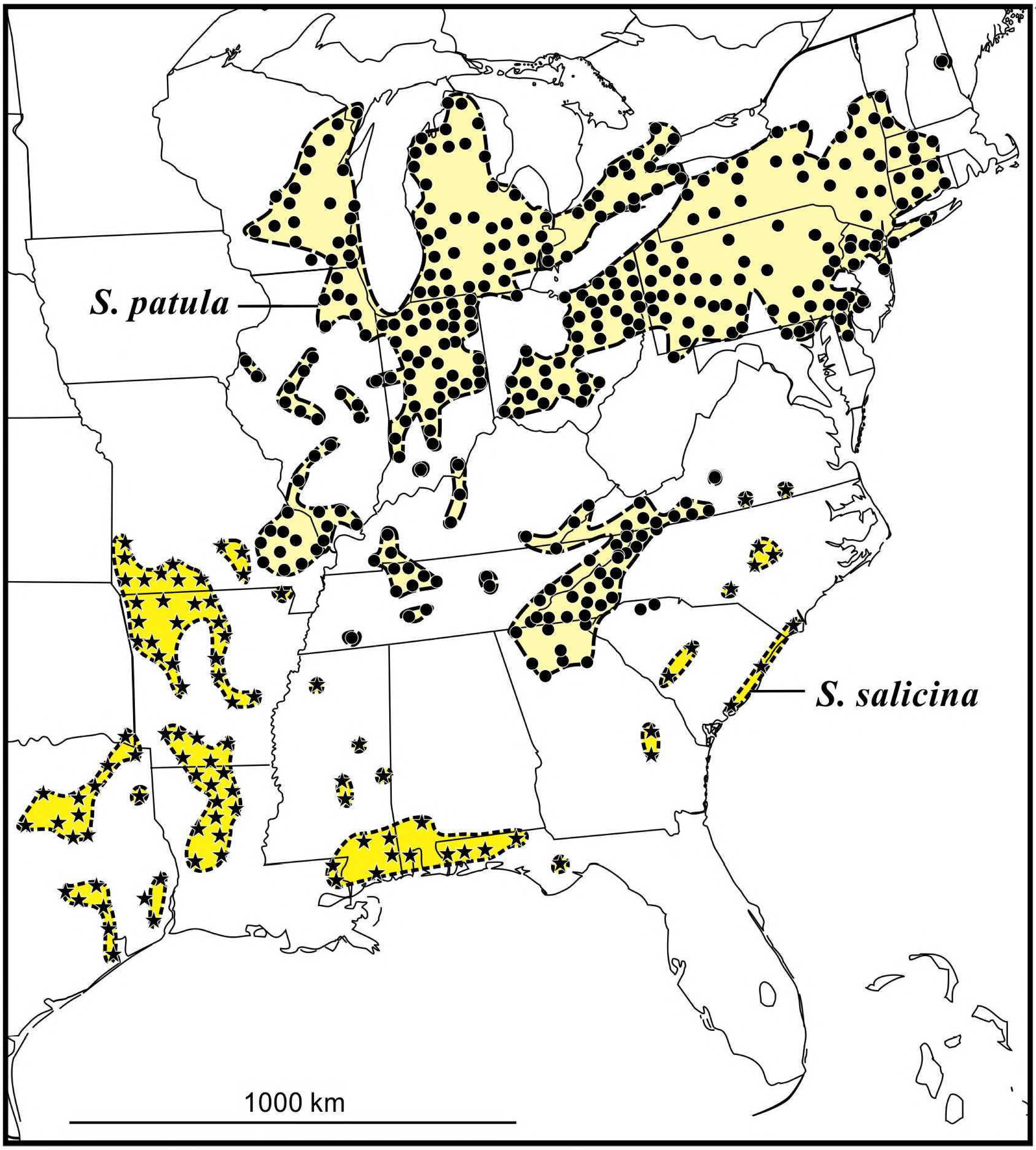

Figure 3. County dot distributions of *Solidago patula* and *S. salicina* based on collections seen and data available online at plants.usda.gov.

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